

A REVIEW OF THE VENOMOUS TOADFISHES

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The venomous toadfishes, genera *Thalassophryne* and *Thalassothia*, are distinguished not alone from other members of the family *Batrachoididae* but from all other fishes, so far as known, by the possession of spines which are perforated for the passage of a venom canal similar to that in the fang of a serpent. (See figs. 1-2.) It is probable that nearly all members of the family have the poison glands more or less well developed, but, so far as is known, in only the two genera mentioned are the spines perforated. Some other species have the spines more or less grooved. (See fig. 3.) The presence of poison glands and of specialized organs for introducing the secretion of these glands into the bodies of other animals is not at all

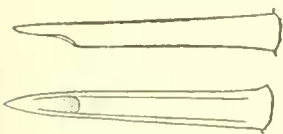


FIG. 1.—DORSAL SPINE OF
THALASSOPHRYNE DOWL.

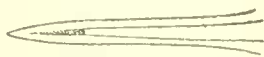


FIG. 2.—OPERCULAR SPINE OF
THALASSOPHRYNE DOWL.



FIG. 3.—OPERCULAR SPINE
OF PORICHTHYS GREENEL.

uncommon in fishes and is not confined to any one group or family; also it is not necessarily a characteristic of all members of any group where it may be found.

The presence of venomous organs among fishes has been denied more or less strongly at times, but is now well proven in many cases and will doubtless be shown in many others as a result of careful study with proper apparatus and manipulation. It has been long known that the wounds caused by the spines of certain fishes produced symptoms far more serious than could be accounted for by the mere mechanical laceration produced by the spines. In some of these cases later research has shown the presence of poison glands on or near the spines, while in the sting rays (*Dasyatis*) and other fishes no such structures have yet been found.

The first record of the specialized venom apparatus of *Thalassophryne* was made in 1864 when Dr. Albert Günther described and figured it.^a His description has been copied many times by various authors. The best abstract of it is probably that given by Dr. Theodore N. Gill^b in his paper on Life Histories of Toadfishes, etc.

To this account we may add that in the specimen of *Thalassophryne reticulata* which we very carefully examined, and in which the skin over the point of the opercular spine had not been ruptured, the poison sac lay along the whole outer surface of the spine and not merely at its base. The sac is so placed that any pressure tending to cause the spine to pierce the skin would produce a corresponding pressure on the contents of the sac and cause the poison to flow into the wound with considerable force. In one specimen the pressure that exposed the point of the spine in a fish that had been in alcohol nearly thirty years caused the contents of the sac to be ejected to a distance of 2 or 3 feet. An unsuccessful attempt was made to test the poisonous properties of the contents of the sac. The failure may have been due to a reduction of the poisonous qualities by preservation or to failure to inject the hardened secretion into the wound. In 1865 a letter from Captain Dow to Doctor Günther was read before the Zoological Society of London,^c in which he described the poison as producing fever similar to the effects of the sting of a scorpion. He adds that serious effects from the poison are very rarely known.

For the purpose of this review we have brought together twenty-one specimens representing five species, including specimens which are evidently Steindachner's cotypes of *Thalassophryne punctata* and *T. nattereri*. We can find no characters which will enable us to separate *Thalassophryne maculosa* Günther from *T. nattereri* Steindachner, so have adopted the older name. This makes *Thalassophryne maculosa* a rather variable species, but the specimens at hand intergrade so closely that we can not separate it at any point. It is possible, although not very probable, that the examination of a large number of specimens would still further reduce the number of species credited to the east coast of South America. We describe one new species, based on the possession of broad incisor teeth and very large eyes. The teeth are very different from those of any other species of *Thalassophryne* known to us, but resembling most closely those of *Thalassophryne reticulata* and being a great development of the tendency shown in the teeth of this species.

^a Proc. Zool. Soc. London, 1864, p. 157, figs. 1 and 2.

^b Life Histories of Toadfishes (Batrachoidids), compared with those of Weevers (Trachinids), and Stargazers (Uranoscopids). Theodore Gill, Smithsonian Miscellaneous Collections (Quarterly Issue), vol. 48, pt. 4, pp. 388-427. *Thalassophryne* is mentioned and figured on pages 402 and 403.

^c Proc. Zool. Soc. London, 1865, p. 677.

The similarity in appearance between *Thalassophryne* and *Porichthys* is shown by the fact that one of the three specimens on which *Thalassophryne dowi* was founded proves to be *Porichthys greenei*.

In our descriptions of species of *Thalassophryne* we have omitted the fish described by De Vis as *Thalassophryne caca*,^a as it is clear from the evidence at hand that this is not a *Thalassophryne*, and it is not certain that it is closely related to that genus. De Vis does not state whether the dorsal spines are hollow or not, and it is not certain from his description that there is an opercular spine developed as a poison organ. He says “gill covers with five spines.” If this means that there are five opercular spines, the fish is very different from *Thalassophryne* and closely related to *Opsanus*, if, indeed, it does not belong to this genus. If, on the other hand, the statement quoted means that the author was misled by appearances and considered the branchiostegal rays as spines, the species is probably a *Porichthys*. The mere fact of the presence of two dorsal spines does not prove the relationship of the fish to *Thalassophryne*. The eye in many species of toadfishes is so small and the iris is colored so much like the rest of the fish that it might easily appear as “an oval spot of lighter colored skin” in a mounted specimen.

In *Thalassophryne* the first ventral ray is simple and articulated, with the spines closely appressed to it at its base, while the second ray is divided to its base.

It is quite remarkable that although many poisonous fishes have the spines grooved, only a single small group, confined, so far as known, to Tropical and South Temperate America, should have developed the apparatus more fully by roofing over the groove and rendering more certain the entrance of the poison into the wound.

We are indebted to the following museums for the loan of material: Stanford University, Museum of Comparative Zoology, Cornell University, and Indiana University.

KEY TO THE GENERA OF VENOMOUS TOADFISHES.

- a¹. Opercular spines hollow for the passage of a venom canal; gill membrane narrow; teeth blunt conic or incisor, not canine.
- b¹. Dorsal spines two, hollow..... *Thalassophryne*.
- b². Dorsal spines four, the first two hollow..... *Thalassothia*.

Genus THALASSOPHRYNE Günther.

Thalassophryne GÜNTHER, Cat. Fish Brit. Mus., vol. 3, p. 175 (1861); Proc. Zool. Soc. London, 1864, p. 150; Trans. Zool. Soc. London, vol. 6, 1865, pp. 436-439, pl. 68.

Thalassophryne MEEK and HALL, Proc. Acad. Nat. Sci. Phila., 1885, pp. 52-62.

Thalassophryne JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus., vol. 3, p. 2323 (Nov. 26, 1898).

^a Proc. Linn. Soc. New South Wales, vol. 9, 1884, p. 546.

Dæctor JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus., vol. 3, p. 2325 (Nov. 26, 1898).

Thalassophryne OGILBY, Ann. Queensland Mus., no. 9, pt. 2, 1908, pp. 46 and 55.

Dæctor OGILBY, Ann. Queensland Mus., no. 9, pt. 2, 1908, pp. 46 and 54.

Dorsal spines two, perforated for the passage of a venom canal as in *Thalassothia*.

Operculum developed as a slender spine, hollow like the dorsal spines.

Teeth blunt conic; present on mandible, maxillary, vomer, and palatines.

Gill membrane narrower than in *Porichthys*, reaching about to the end of the opercular spine.

This genus differs from *Thalassothia* in the number of dorsal spines; in the first rays of the anal not being separated from the rest of the fin, and probably in the somewhat slenderer body.

Thalassophryne differs from *Porichthys* in the dentition, in the character of the spines, and in the width of the gill membrane.

The teeth of *Thalassophryne* resemble those of young specimens of *Opsanus tau* very closely and are very different from those of *Porichthys*.

KEY TO THE SPECIES OF THALASSOPHRYNE.

- a*¹. Eye small, 8 to 12 in head, teeth conic, more or less flattened at tip.
 - b*¹. Dorsal and anal fully joined to caudal.
 - c*¹. Dorsal and anal long, about 30 rays in each.....*dowi*.
 - c*². Dorsal and anal shorter, about 20 rays in each.....*amazonica*.
 - b*². Dorsal and anal not united to caudal, the fin membrane behind last rays reaching to base of outer caudal rays.
 - d*¹. Teeth conic, only slightly flattened at tip.
 - e*¹. Color dark brown with numerous spots of black the size of the eye and smaller. Teeth in a narrow patch across head of vomer.....*punctata*.
 - e*². Color brown, more or less marbled with darker but without conspicuous spots of black. Teeth in a single row across head of vomer.....*maculosa*.
 - d*². Teeth broad, almost incisor, oval in front view with a long cutting edge; color dark grayish with a reticulation of grayish white lines.....*reticulata*.
- a*². Eye large, 5 to 6 in head, teeth broad incisors, cutting edge nearly straight.....*megalops*.

THALASSOPHRYNE DOWI Jordan and Gilbert.

Thalassophryne dowi JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 10, 1887, p. 388.

Dæctor^a *dowi* JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus., pt. 3, p. 2325, Nov. 26, 1898.

Thalassophryne dowi GILBERT and STARKS, Mem. California Acad. Nat. Sci., vol. 4, 1904, p. 187.

^a We can find no characters except the slightly longer dorsal and anal fins, the somewhat more elongate body, and other differences in proportions which separate this species from the rest of the genus *Thalassophryne*. These characters taken alone are not worthy of generic or subgeneric rank. The main character on which the genus *Dæctor* was founded was the joining of the dorsal and anal fins to the caudal. This, taken in connection with the greater length of the dorsal and anal and the more elongate form would probably constitute a valid genus. However, *Thalassophryne*

Head $3\frac{1}{2}$. Depth $5\frac{1}{4}$. D. 11-31. A. 30. P. 17. V. I, 2. C. 14.

Body comparatively elongate, compressed behind. Head low and rather narrow, its length $1\frac{1}{3}$ times its width.

Eyes very small, about $1\frac{1}{4}$ in snout and $2\frac{2}{5}$ in interorbital space, 11 in head. Interorbital width $4\frac{1}{2}$ in head. Opercular spine $3\frac{1}{4}$ to 4 in head. Mouth oblique, the lower jaw much projecting. Maxillary $2\frac{2}{3}$ in head, reaching behind eye. Mandible $1\frac{7}{8}$ in head. Teeth moderate, largest on palatines, present on premaxillaries, mandible, vomer, and palatines. Teeth in a very narrow cardiform band, scarcely more than one row, on mandible and premaxillary; sometimes plainly two rows on mandible. A single row across the head of the vomer and on the palatines. The teeth are all conic, slightly flattened at tip. In large specimens the two enlarged teeth on the head of the vomer are very much worn off and blunted by use. The teeth are somewhat longer than in others of the genus but do not form enlarged canines as in *Porichthys*. Pectoral fins obliquely rounded, $1\frac{1}{2}$ in head, reaching to about fifth anal ray. Caudal rounded. Last rays of dorsal and anal fully joined to caudal as in *Thalassophryne amazonica*.

Color in alcohol, dark gray, darkest at base of the dorsal fins, black on the spinous dorsal. Other specimens are reddish brown becoming black on the spinous dorsal and below the base of the soft dorsal. This ground

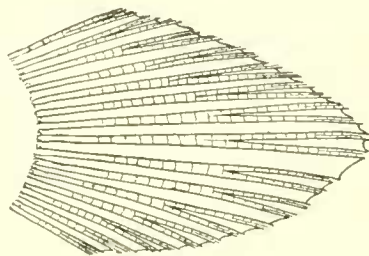


FIG. 4.—PECTORAL FIN OF PORICHTHYS GREENEI.

color in either case is extensively broken up by fine marblings and mottlings of white or pale gray and disappears entirely above the middle of the side in the brown specimens. In the gray specimens the body color is carried farther down on the side and ends much less abruptly than in those with the brown color. The top of the dorsal, the end of the caudal and a short band on the ends of the last anal rays is black. Below or in front of this is a band of white in the brown specimens or of pale gray in the gray ones. This covers all but the extreme base of the dorsal rays and about half the length of the upper caudal rays. On the lower caudal rays and the anal the white or light gray is continuous with the color of the body. Just below the base of the dorsal the color is interrupted by the white lateral line.

We have examined and measured nine specimens of this species ranging from about 4.5 cm. to 15.6 cm. in total length. The list is as follows:

reticulata has only four or five fewer rays in dorsal and anal; *Thalassophryne amazonica* has a short dorsal and anal which are fully joined to the caudal, and a rather elongate form, and the teeth are the same in several other species of *Thalassophryne*, as in *T. dowi*. These considerations so reduce the value of the characters assigned to the genus *Dactor* that we can not even accord it subgeneric rank.

No. 1555, Indiana University, Punta Arenas. Dredged. Coll. Dr. Wesley Newcomb. (Old number 923.) About 4.5 cm. long. This is one of the cotypes of *Thalassophryne dowi*.^a

No. 410, Leland Stanford Jr. University, Panama. Coll. *Albatross*. Two specimens, 6.5 cm. long and 14.1 cm. long.

No. 39085, U. S. Nat. Mus., Punta Arenas, Costa Rica. Coll. Dr. Wesley Newcomb. One specimen, 9.7 cm. long. Type of *Thalassophryne dowi*.

No. 41232, U. S. Nat. Mus., station 2800, str. *Albatross*, 8° 51' N., 79° 31' 30'' W., March 30, 1888; 7 fathoms; bottom green mud. Bay of Panama. Two specimens, 10.6 cm. and 12.5 cm. long.

No. 41430, U. S. Nat. Mus., station 2800, str. *Albatross*. One specimen, 13.1 cm. long.

No. 6875, Leland Stanford Jr. University Museum, Panama. Coll. C. H. Gilbert. One specimen, 15.6 cm. long. This specimen was figured by D. S. Jordan in the plate which we copy from Proc. Cal. Acad. Sci. 1896, ser. 2, vol. 6, p. 231, pl. 38.

No. 2100, Cornell University Museum, Panama. Coll. Dr. Wesley Newcomb. One specimen, 11.3 cm. long.

^a The first recorded specimen of *Thalassophryne dowi* was collected by Dr. C. H. Gilbert through the agency of Captain Dow and was given the manuscript name *dowi* in his honor. This specimen was destroyed in the Indiana University fire. Later Dr. B. G. Wilder sent Dr. D. S. Jordan three specimens, probably collected by Captain Dow for Doctor Newcomb. These specimens were:

No. 1555, Cornell University Museum, from Panama. From Dr. Wesley Newcomb. Dredged. One specimen.

No. 1556, Cornell University Museum, Punta Arenas, Costa Rica. Dredged. Two specimens.

One specimen numbered 1556 was sent by Doctor Jordan to the U. S. National Museum as the type of the new species. One of the others was returned to Doctor Wilder as a cotype. This specimen has been examined by us and proves to be a *Porichthys*, probably *greenei*. The third specimen (numbered 1555?) can not be found unless the one sent us from the Indiana University is the same, in which case it should be recorded as Panama, Coll. Newcomb, instead of Punta Arenas, Coll. S. E. Meek.

(In reply to our request for information as to whether he had collected fishes in Costa Rica as indicated on the original label sent with the Indiana University specimen, we have the following letter from Doctor Meek:

"When I went to Cornell University in 1885 I found there some fishes which I was sure were new. I sent them to Doctor Jordan and he wrote me it was a species he had described but type and description were burned in the fire at Indiana University in 1883. I sent him the data and he described the species. I did not collect the specimens and know no more about them. It is quite certain the fishes in question were collected by Doctor Newcomb at Punta Arenas, Costa Rica.

"(Signed) S. E. MEEK.

"CHICAGO, ILL., May 9, 1910.")

Doctor Wilder had a third specimen, No. 2100, which he did not send to Doctor Jordan.

Measurements of nine specimens of *Thalassophryne dowi*.

[If less than nine specimens were measured, the exact number is indicated in parentheses.]

	Maximum.	Minimum.	Average.	
Total length.....	15.6 cm.		11.7 cm. (8)	
Standard length.....	13.6 cm.	3.9 cm.	9.5 cm.	
Body:				
Depth.....	.206	.155	.189	5.29 in standard length.
Width.....	.177	.141	.158	6.33 in standard length.
Depth at ventrals.....	.172	.149	.161	6.21 in standard length.
Depth of caudal peduncle.....	.063	.053	.056	5.11 in head.
Head:				
Length.....	.316	.264	.286	3.50 in standard length.
Width.....	.240	.192	.221	4.52 in standard length.
Interorbital width.....	.089	.055	.063	4.54 in head.
Snout.....	.041	.027	.032	8.93 in head.
Maxillary.....	.125	.110	.117	8.55 in standard length.
Mandible.....	.162	.143	.157	2.67 in head.
Orbit.....	.039	.018	.026	6.37 in standard length.
Dorsal (spinous):				
Distance from snout.....	.280	.248	.262	11.83 in head.
Length of base.....	.104	.071	.095	11.0 in head.
Height of first spine.....	.091	.063	.078	
Height of second spine.....	.098	.081	.088	
Dorsal (soft):				
Distance from snout.....	.393	.359	.378	2.65 in standard length.
Length of base.....	.641	.607	.622	1.61 in standard length.
Height of first ray.....	.082	.048	.070 (8)	4.09 in head.
Height of longest ray.....	.178	.115	.139 (8)	2.06 in head.
Height of last ray.....	.178	.155	.088 (8)	3.25 in head.
Anal:				
Distance from snout.....	.411	.384	.391	2.56 in standard length.
Length of base.....	.616	.589	.609	1.64 in standard length.
Height of first ray.....	.060	.037	.048 (8)	5.96 in head.
Height of longest ray.....	.095	.059	.077 (8)	3.71 in head.
Height of last ray.....	.063	.044	.057 (8)	5.02 in head.
Caudal:				
Length of middle rays.....	.161	.137	.152 (8)	1.88 in head.
Length of outer rays.....	.125	.051	.093 (4)	3.08 in head.
Pectoral:				
Distance from snout.....	.303	.266	.286	3.50 in standard length.
Length.....	.214	.177	.193	5.18 in standard length.
Ventral:				
Distance from snout.....	.194	.161	.179	11.48 in head.
Length.....	.143	.103	.123	5.59 in standard length.
Branchiostegals.....	6	6	6	8.13 in standard length.
Dorsal.....	II-33	II-29	II-31	2.33 in head.
Anal.....	33	29	30	
Caudal.....	16	13	14	
Pectoral.....	18	16	17 (8)	
Ventral.....	1,2	1,2	1,2	

THALASSOPHRYNE AMAZONICA Steindachner.

Thalassophryne amazonica STEINDACHNER, Sitzungs- b. kais. Akad. Wiss. Wien., vol. 74, pt. 1, June-Dec., 1876, p. 161.

Thalassophryne amazonica MEEK and HALL, Proc. Acad. Nat. Sci. Phila., 1885, p. 54.

Head 3 $\frac{2}{5}$. D. II-20. A. 18. P. 13-14. V. I, 2.

Body rather elongate. Head rather narrow, 1 $\frac{1}{3}$ longer than wide. Eyes small. Snout less than interorbital width. Interorbital width twice eye. Opercular spine long and slender. Mouth oblique, the lower jaw prominent. Teeth conic, more or less blunt, smallest in

premaxillary and largest on vomer. The teeth are uniserial, except near the symphysis of the mandible, where they are in two rows. Pectoral long and pointed, reaching third or fourth anal ray. Last rays of dorsal and anal fully joined to the caudal as in *Thalassophryne dori*.

Color bright brown with spots and marblings of darker. Two faint dark cross bands on head. Five (or six?) dark cross bands on body; the first covering the spinous dorsal, the other four (or five?) along the soft dorsal. The dark brown spots form irregular rows on the dorsal, anal and pectoral fins.

We have not been able to examine any specimens of this species and know it only from Steindachner's original description which was apparently based on three or more specimens.

THALASSOPHRYNE PUNCTATA Steindachner.

Thalassophryne punctata STEINDACHNER, Sitzungsab. kais. Akad. Wiss. Wien., vol. 74, pt. 1, June-Dec., 1876, p. 169.

Thalassophryne punctata MEEK and HALL, Proc. Acad. Nat. Sci. Phila., 1885, p. 54.

Head $2\frac{3}{4}$ to $2\frac{7}{8}$. Depth $3\frac{3}{4}$ to 4. D. II-20 to 21. A. 19. P. 15. V. I, 2. C. 14 to 15.

Body short and thick, compressed behind. Head low and broad, the length and width about equal. Eyes very small, $1\frac{1}{3}$ to $1\frac{1}{2}$ in snout and $2\frac{1}{4}$ to $2\frac{1}{2}$ in interorbital width, 11 to 12 in head. Interorbital width 5 in head (4 according to Steindachner). Opercular spine about 3 in head. Mouth nearly vertical, the lower jaw much projecting. Maxillary 2 to $2\frac{1}{4}$ in head, reaching behind eye. Mandible $1\frac{1}{2}$ in head. Teeth small, conic, with the tips slightly flattened; in two rows near symphysis of mandible, in a very narrow band on premaxillary, in a narrow patch across head of vomer, elsewhere uniserial. Pectoral fins obliquely rounded, reaching to about fifth or sixth anal ray, $1\frac{1}{3}$ to $1\frac{1}{2}$ in head. Caudal strongly rounded. The fin membrane behind the last dorsal and anal rays just reaches the base of the caudal rays.

Color in alcohol: Above brown, below dirty white, the fins all margined with dark brown, shading to the body color at the base of the fin, the anal, ventral and lower rays of the pectoral with small white tips. A very narrow yellowish tip to caudal. The upper surface of the body and all the fins, except the anal and ventrals, thickly covered with small round black spots, some of which are as large as the eye, the others smaller.



FIG. 5.—TOOTH OF THALASSOPHRYNE PUNCTATA.
X 16 DIAMETERS. FISH,
15.2 CM. LONG.

We have examined two specimens of this species, as follows:
No. 4632, Mus. Comp. Zoöl., Porto Seguro, Brazil. Coll. Hartt and Copeland, Thayer Expedition. One specimen, 16.3 cm. long. Cotype of *Thalassophryne punctata*.
No. 12725, Mus. Comp. Zoöl., Bahia, Brazil. Coll. C. F. Hartt, 1867. One specimen, 15.2 cm. long.

Measurements of two specimens of *Thalassophryne punctata*.

	No. 12725, Mus. Comp. Zoöl.		No. 4632, Mus. Comp. Zoöl. (cotype).	
Total length.....	15.2 cm.....		16.3 cm.	
Standard length.....	12.7 cm.....		13.1 cm.	
Body:				
Depth.....	.244	4.10 in standard length.....	.267	3.75 in standard length.
Width.....	.244	4.10 in standard length.....	.267	3.75 in standard length.
Depth at ventral fins.....	.189	5.29 in standard length.....	.198	5.05 in standard length.
Depth of caudal peduncle.....	.087	4.07 in head.....	.099	3.67 in head.
Head:				
Length.....	.354	2.82 in standard length.....	.366	2.73 in standard length.
Width.....	.346	2.89 in standard length.....	.359	2.79 in standard length.
Interorbital width.....	.071	5.00 in head.....	.076	4.8 in head.
Length of snout.....	.043	8.24 in head.....	.042	8.72 in head.
Length of maxillary.....	.157	6.33 in standard length.....	.175	5.71 in standard length.
		2.26 in head.....		2.09 in head.
Length of mandible.....	.236	4.24 in standard length.....	.244	4.10 in standard length.
		1.50 in head.....		1.50 in head.
Diameter of orbit.....	.029	12.2 in head.....	.034	10.8 in head.
Dorsal (spinous):				
Distance from snout.....	.354	2.82 in standard length.....	.305	3.28 in standard length.
Length of base.....	.079	4.48 in head.....	.122	3.00 in head.
Height at first spine.....	.063	5.63 in head.....	.076	4.82 in head.
Height at second spine.....	.079	4.48 in head.....	.076	4.82 in head.
Dorsal (soft):				
Distance from snout.....	.449	2.23 in standard length.....	.458	2.18 in standard length.
Length of base.....	.551	1.81 in standard length.....	.542	1.85 in standard length.
Height at first ray.....	.118	3.00 in head.....	.130	2.82 in head.
Height at longest ray.....	.165	2.14 in head.....	.183	2.02 in head.
Height at last ray.....	.095	3.72 in head.....	.114	3.21 in head.
Anal:				
Distance from snout.....	.519	1.93 in standard length.....	.495	2.02 in standard length.
Length of base.....	.481	2.08 in standard length.....	.505	1.98 in standard length.
Height at first ray.....	.071	5.00 in head.....	.069	5.30 in head.
Height at longest ray.....	.142	2.50 in head.....	.130	2.82 in head.
Height at last ray.....	.087	4.07 in head.....	.099	3.67 in head.
Caudal:				
Length of middle rays.....	.197	1.80 in head.....	.244	2.00 in head.
Length of outer rays.....	.126	2.81 in head.....	.092	3.98 in head.
Pectoral:				
Distance from snout.....	.370	2.70 in standard length.....	.382	2.62 in standard length.
Length.....	.268	3.73 in standard length.....	.244	4.10 in standard length.
		1.3 in head.....		1.5 in head.
Ventral:				
Distance from snout.....	.228	4.39 in standard length.....	.239	4.18 in standard length.
Length.....	.165	6.06 in standard length.....	.191	5.24 in standard length.
		2.54 in head.....		1.92 in head.
Branchiostegals.....	6.....		6.....	
Dorsal.....	11-21.....		11-20.....	
Anal.....	19.....		19.....	
Caudal.....	14.....		15.....	
Pectoral.....	15.....		15.....	
Ventral.....	1, 2.....		1, 2.....	

THALASSOPHRYNE MACULOSA Günther.

Thalassophryne maculosa GÜNTHER, Cat. Fish. Brit. Mus., vol. 3, p. 175, 1861.
Thalassophryne maculosa GÜNTHER, Trans. Zool. Soc. London, vol. 6, 1865, p. 436, pl. 68.
Thalassophryne nattereri STEINDACHNER, Sitzungsab. kais. Akad. Wiss. Wien., vol. 74, pt. 1, June-Dec., 1876, p. 163.
Thalassophryne maculosa and *Thalassophryne nattereri* MEEK and HALL, Proc. Acad. Nat. Sci. Phila., 1885, pp. 53-54.
Thalassophryne maculosa JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus., vol. 3, p. 2324.

Head $2\frac{1}{2}$ to 3. Depth $3\frac{1}{2}$ to 4. D. II-20. A. 19. P. 14 to 16. V. I, 2. C. 14 to 15.

Body short and thick, compressed behind. Head low, about as long as broad. Eyes very small, less than snout, about half interorbital width, $9\frac{1}{2}$ to 12 in head. Interorbital width $4\frac{2}{3}$ to $5\frac{1}{3}$ in head. Opercular spine about 3 in head. Mouth oblique, the lower jaw much projecting. Maxillary $2\frac{1}{5}$ to $2\frac{1}{2}$ in head, reaching behind eye. Mandible $1\frac{1}{2}$ to $1\frac{2}{3}$ in head. Teeth moderate, largest on palatines, in two rows on front of mandible, in a very narrow band on premaxillary, elsewhere uniserial. The teeth are rather bluntly conical and somewhat flattened at tip. Pectoral fins obliquely rounded, $1\frac{1}{3}$ to $1\frac{2}{5}$ in head, reaching about to sixth anal ray. Caudal rounded. The membrane from the last rays of dorsal and anal reaches to about the middle of the outer caudal rays in one specimen, to the base of these rays in others.

Color in alcohol: Brownish above, becoming abruptly white below in the cotype of *Thalassophryne nattereri*. In this specimen, as in one



FIG. 6.—TOOTH OF THALASSOPHRYNE MACULOSA.
X 16 DIAMETERS. FISH, 16 CM. LONG.

other which we have examined, the fins are all margined with white, below which is a dark band which is darker than the color of the back. In the third specimen examined the dorsal lacks the white margin and the color is much darker, practically as described for *Thalassophryne maculosa*.

We can find no characters which will separate *Thalassophryne maculosa* Günther and *Thalassophryne nattereri* Steindachner. In the original descriptions they are separated by the color and by the supposed fact that one had one more ray in dorsal and anal than the other. In our examination we find that the cotype of *Thalassophryne nattereri* has the fin count of *Thalassophryne maculosa*, while another specimen very similar to the cotype and one intermediate in coloration or nearer to *Thalassophryne maculosa* have the number of rays assigned to *T. nattereri*.

We have examined three specimens of this species, as follows:

No. 12726, Mus. Comp. Zoöl., Para, Brazil. Coll. L. Agassiz, Thayer Expedition. One specimen 10.6 cm. long. Cotype of *Thalassophryne nattereri*.

No. 12724, Mus. Comp. Zoöl., Curuea, Brazil, a small place on the coast just south of the mouth of the Amazons. Coll. L. Agassiz, Thayer Expedition. Two specimens, 13.7 cm. long and 16 cm. long.

Measurements of three specimens of *Thalassophryne maculosa*.

	No. 12726, Mus. Comp. Zool. (eotype of <i>Thalassophryne nattereri</i>).		No. 12724, Mus. Comp. Zool.		No. 12724, Mus. Comp. Zool.	
Total length.....	10.6 cm.		13.7 cm.		16.0 cm.	
Standard length.....	8.5 cm.		11.1 cm.		13.1 cm.	
Body:						
Depth.....	.282	3.55 in standard length.	.251	3.98 in standard length.	.252	3.97 in standard length.
Width.....	.259	3.86 in standard length.	.279	3.58 in standard length.	.275	3.64 in standard length.
Depth at ventral fins.	.212	4.72 in standard length.	.189	5.29 in standard length.	.191	5.24 in standard length.
Depth of caudal peduncle.	.094	4.12 in head.	.081	4.11 in head.	.099	3.67 in head.
Head:						
Length.....	.387	2.58 in standard length.	.333	3.0 in standard length.	.366	2.73 in standard length.
Width.....	.341	2.93 in standard length.	.351	2.85 in standard length.	.366	2.73 in standard length.
Interorbital width....	.071	5.4 in head.	.063	5.3 in head.	.080	4.6 in head.
Length of snout.....	.047	8.24 in head.	.041	8.13 in head.	.038	9.63 in head.
Length of maxillary ..	.176	5.68 in standard length.	.135	7.41 in standard length.	.160	6.25 in standard length.
Length of mandible ..	.235	2.2 in head. 4.26 in standard length.	.225	2.5 in head. 4.44 in standard length.	.236	2.3 in head. 4.24 in standard length.
Diameter of orbit.....	.041	1.6 in head. 9.4 in head.	.027	1.5 in head. 12.3 in head.	.031	1.5 in head. 11.8 in head.
Dorsal (spinous):						
Distance from snout..	.318	3.14 in standard length.	.270	3.71 in standard length.	.298	3.36 in standard length.
Length of base.....	.129	3.00 in head.	.117	2.84 in head.	.107	3.42 in head.
Height at first spine..	.094	4.12 in head.	.090	3.70 in head.	.092	3.98 in head.
Height at second spine	.106	3.65 in head.	.108	3.08 in head.	.099	3.67 in head.
Dorsal (soft):						
Distance from snout..	.470	2.13 in standard length.	.459	2.18 in standard length.	.412	2.43 in standard length.
Length of base.....	.530	1.89 in standard length.	.541	1.85 in standard length.	.588	1.70 in standard length.
Height at first ray....	.153	2.53 in head.	.135	2.46 in head.	.107	3.42 in head.
Height at longest ray..	.176	2.20 in head.	.180	1.85 in head.	.168	2.18 in head.
Height at last ray ....	.106	3.65 in head.	.099	3.33 in head.	.099	3.67 in head.
Anal:						
Distance from snout..	.494	2.02 in standard length.	.459	2.18 in standard length.	.495	2.02 in standard length.
Length of base.....	.506	1.98 in standard length.	.541	1.85 in standard length.	.505	1.98 in standard length.
Height at first ray....	.082	4.72 in head.	.072	4.63 in head.	.069	5.30 in head.
Height at longest ray..	.153	2.53 in head.	.135	2.46 in head.	.122	3.00 in head.
Height at last ray ....	.094	4.12 in head.	.090	3.70 in head.	.092	3.98 in head.
Caudal:						
Length of middle rays.	.247	1.57 in head.	.234	1.44 in head.	.221	1.66 in head.
Length of outer rays..	.129	3.00 in head.	.045	7.40 in head.	.076	4.82 in head.
Pectoral:						
Distance from snout..	.377	2.65 in standard length.	.333	3.00 in standard length.	.390	2.56 in standard length.
Length.....	.282	3.55 in standard length. 1.4 in head.	.252	3.97 in standard length. 1.3 in head.	.259	3.86 in standard length. 1.4 in head.
Ventral:						
Distance from snout..	.188	5.32 in standard length.	.189	5.29 in standard length.	.244	4.10 in standard length.
Length.....	.200	5.00 in standard length. 1.94 in head.	.162	6.17 in standard length. 2.03 in head.	.153	6.51 in standard length. 2.39 in head.
Branchiostegals.....	6.		6.		6.	
Dorsal.....	11-20.		11-20.		11-20.	
Anal.....	19.		19.		19.	
Caudal.....	14.		15.		14.	
Pectoral.....	14.		16.		17.	
Ventral.....	1, 2.		1, 2.		1, 2.	

THALASSOPHRYNE RETICULATA Günther.

Thalassophryne reticulata GÜNTHER, Proc. Zool. Soc. London, 1864, pp. 150 and 155.

Thalassophryne reticulata GÜNTHER, Trans. Zool. Soc. London, vol. 6, 1868, p. 437, pl. 68.

Thalassophryne reticulata MEEK and HALL, Proc. Acad. Nat. Sci. Phila., 1885, pp. 54 and 55.

Thalassophryne reticulata SAVTSCHENKO, Atlas des Poissons Vénéneux, 1886, p. 39, pl. 10, fig. 1.

Thalassophryne reticulata JORDAN and EVERMANN, Bull. 47, U. S. Nat. Mus., vol. 3, p. 2325, November 26, 1898.

Thalassophryne reticulata GILBERT and STARKS, Mem. California Acad. Nat. Sci., vol. 6, 1904, p. 186.

Head 3. Depth $5\frac{2}{5}$. D. II-27. A. 25. P. 17. V. I, 2. C. 12.

Body moderately elongate, compressed behind. Head low, the width slightly less than the length, the difference about equal to length of orbit. Eyes small, a little less than snout and 1.7 in interorbital space, $8\frac{3}{5}$ in head. Interorbital width 5 in head. Opercular

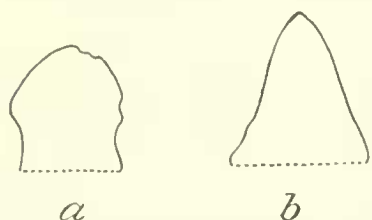


FIG. 7.—TOOTH OF THALASSOPHRYNE RETICULATA. $\times 16$ DIAMETERS. FISH, 26.7 CM. LONG.

spine $3\frac{1}{4}$ to 5 in head. Mouth nearly vertical, the lower jaw very prominent. Maxillary $2\frac{1}{5}$ in head, reaching behind eye. Mandible $1\frac{2}{3}$ in head. Teeth rather short, conic incisors, oval in front view, with a long cutting edge extending nearly around the exposed part of the tooth, uniserial in mandible, premaxillary, vomer, and palatines, except that near the symphysis of the mandible

and near the front of the premaxillary the teeth are crowded so as to appear in two very irregular rows or a narrow cardiform band. There are no teeth on the shaft of the vomer, the single row of teeth on that bone being a direct continuation of the row on the palatines. There is no indication of a tendency to form canines in fish of any size. Pectoral fins obliquely rounded, $1\frac{1}{3}$ in head, reaching to about sixth or seventh anal ray (eighth in the smallest specimen). Caudal rounded except in the smallest specimen, where it has the upper and lower rays (one upper and one lower ray) much produced, the middle rays $1\frac{3}{5}$ in length of outer ones. The fin membrane behind the last dorsal and anal rays just reaches to the base of the caudal rays.

Color in alcohol dark gray with a conspicuous reticulation of grayish white lines above, grayish white below. The spinous dorsal is black. All the other fins are colored like the back and edged with white. Whole mandibular region colored like the back, but with finer reticulations.

We have examined five specimens of this species, as follows:

No. 6874, Leland Stanford, Jr., University Museum, Panama. Coll. C. H. Gilbert. Four specimens, 6.6 cm., 20.9 cm., 24.2 cm., and 26.7 cm. long.

No. 50409, U. S. Nat. Mus., Panama. Coll. C. H. Gilbert. One specimen, 29.7 cm. long.

Measurements of five specimens of *Thalassophryne reticulata*.

	Maximum.	Minimum.	Average.	
Total length.....	29.7 cm.	6.6 cm.	21.6 cm.	
Standard length.....	24.8 cm.	5.5 cm.	18.0 cm.	
Body:				
Depth.....	.198	.164	.185	5.41 in standard length.
Width.....	.222	.198	.210	4.77 in standard length.
Depth at ventral fins.....	.169	.157	.165	6.06 in standard length.
Depth of caudal peduncle.....	.073	.059	.064	5.12 in head.
Head:				
Length.....	.331	.323	.327	3.06 in standard length.
Width.....	.320	.297	.305	3.28 in standard length.
Interorbital width.....	.076	.058	.066	4.96 in head.
Snout.....	.045	.035	.041	7.98 in head.
Maxillary.....	.153	.144	.148	6.76 in standard length.
Mandible.....	.202	.192	.197	2.21 in head.
Orbit.....	.055	.028	.038	5.08 in standard length.
Dorsal (spinous):				1.66 in head.
Distance from snout.....	.296	.255	.279	8.61 in head.
Length of base.....	.116	.081	.102	3.58 in standard length.
Height of first spine.....	.109	.076	.092	3.21 in head.
Height of second spine.....	.099	.072	.086	3.56 in head.
Dorsal (soft):				3.80 in head.
Distance from snout.....	.442	.382	.421	2.37 in standard length.
Length of base.....	.618	.558	.579	1.73 in standard length.
Height of first ray.....	.104	.081	.093	3.52 in head.
Height of longest ray.....	.182	.129	.147	2.22 in head.
Height of last ray.....	.109	.079	.094	3.48 in head.
Anal:				
Distance from snout.....	.455	.418	.444	2.25 in standard length.
Length of base.....	.582	.545	.556	1.80 in standard length.
Height of first ray.....	.091	.049	.061	5.37 in head.
Height of longest ray.....	.127	.099	.112	2.92 in head.
Height of last ray.....	.091	.069	.077	4.25 in head.
Caudal:				
Length of middle rays.....	.215	.127	.187	1.75 in head.
Length of outer rays.....	.200	.141	.161	2.03 in head.
Pectoral:				
Distance from snout.....	.350	.327	.343	2.91 in standard length.
Length.....	.309	.222	.246	4.07 in standard length.
Ventral:				1.33 in head.
Distance from snout.....	.202	.164	.186	5.38 in standard length.
Length.....	.200	.145	.165	6.06 in standard length.
Branchiostegals.....	5	5	5	1.98 in head.
Dorsal.....	II-27	II-26	II-27	
Anal.....	25	25		
Caudal.....	12	10	12	
Pectoral.....	17	17	17	
Ventral.....	I,2	I,2	I,2	

THALASSOPHRYNE MEGALOPS Bean and Weed, new species.

Head 2½ to 2¾. Depth 3½. D. II-18 or 19. A. 17. P. 13 to 14. V. I, 2. C. 14.

Body short and stout, compressed behind. Head low, its length slightly greater (one-seventh to two-ninths) than its width. Eyes large, 5½ to 5½ in head. Eyes 1½ to 1½ times length of snout, equal to interorbital width. Interorbital width 5.3 to 5.5 in length of head. Opercular spine 3¼ to 4 in head. Mouth oblique, the lower jaw much projecting. Maxillary 2 in head, reaching past eye. Mandible 1¾ in head. Teeth broad incisors, uniserial on premaxillary, mandible, vomer and palatines. The illustration shows the front and side of a tooth from the left palatine. Pectoral fins obliquely rounded, reaching to about fourth anal ray, 1½ in head. Caudal



FIG. 8.—TOOTH OF THALASSOPHRYNE MEGALOPS. X 16 DIAMETERS. FISH, 6.9 CM. LONG.

rounded. Fin membrane from last rays of dorsal and anal reaching to base of caudal rays.

The color is entirely lost in our specimens with the exception of a small dark spot at the top of the spinous dorsal.

Thalassophryne megalops differs from the other species of the genus in the very large eye and in the large, broad incisor teeth, which are proportionally two or three times as broad as in the other species.

We have examined and measured two specimens, the larger the type, both of them No. 37669, U. S. Nat. Mus., from fisheries steamer *Albatross*, station 2142, in the Gulf of Darien, at a depth of 42 fathoms. Taken March 29, 1884. The specimens are 5.4 cm. and 6.9 cm. long, respectively.

Measurements of the type and cotype of Thalassophryne megalops.

	Cotype, No. 37669, U. S. Nat. Mus.		Type, No. 37669, U. S. Nat. Mus.	
Total length.....	5.4 cm.		6.9 cm.	
Standard length.....	4.3 cm.		5.5 cm.	
Body:				
Depth.....	.279	3.58 in standard length.....	.291	3.44 in standard length.
Width.....	.256	3.91 in standard length.....	.291	3.44 in standard length.
Depth at ventral fins.....	.209	4.79 in standard length.....	.200	5.00 in standard length.
Depth of caudal peduncle.....	.105	3.54 in head.....	.096	4.17 in head.
Head:				
Length.....	.372	2.69 in standard length.....	.400	2.50 in standard length.
Width.....	.326	3.07 in standard length.....	.327	3.06 in standard length.
Interorbital width.....	.070	5.3 in head.....	.073	5.5 in head.
Length of snout.....	.047	7.92 in head.....	.055	7.27 in head.
Length of maxillary.....	.186	5.38 in standard length.....	.182	5.49 in standard length.
Do.....	.233	2.0 in head.....		2.2 in head.
Diameter of orbit.....	.070	4.29 in standard length.....	.255	3.92 in standard length.
Do.....		1.6 in head.....		1.6 in head.
Diameter of orbit.....	.070	5.3 in head.....	.073	5.5 in head.
Dorsal (spinous):				
Distance from snout.....	.337	2.97 in standard length.....	.364	2.75 in standard length.
Length of base.....	.116	3.20 in head.....	.100	4.00 in head.
Height at first spine.....	.139	2.68 in head.....	.109	3.76 in head.
Height at second spine.....	.116	3.20 in head.....	.127	3.14 in head.
Dorsal (soft):				
Distance from snout.....	.465	2.15 in standard length.....	.491	2.04 in standard length.
Length of base.....	.535	1.87 in standard length.....	.509	1.96 in standard length.
Height at first ray.....	.116	3.20 in head.....	.109	3.76 in head.
Height at longest ray.....	.174	2.14 in head.....	.145	2.76 in head.
Height at last ray.....	.070	5.32 in head.....	.082	4.88 in head.
Anal:				
Distance from snout.....	.512	1.95 in standard length.....	.509	1.96 in standard length.
Length of base.....	.488	2.05 in standard length.....	.491	2.04 in standard length.
Height at first ray.....	.093	4.00 in head.....	.073	5.48 in head.
Height at longest ray.....	.116	3.20 in head.....	.136	2.94 in head.
Height at last ray.....	.093	4.00 in head.....	.100	4.00 in head.
Caudal:				
Length of middle rays.....	.256	1.45 in head.....	.255	1.57 in head.
Length of outer rays.....	.163	2.28 in head.....	.136	2.94 in head.
Pectoral:				
Distance from snout.....	.396	2.53 in standard length.....	.400	2.50 in standard length.
Length.....	.256	3.91 in standard length.....	.291	3.44 in standard length.
Do.....		1.41 in head.....		1.37 in head.
Ventral:				
Distance from snout.....	.233	4.29 in standard length.....	.255	3.92 in standard length.
Length.....	.163	6.13 in standard length.....	.200	5.00 in standard length.
Do.....		2.28 in head.....		2.00 in head.
Branchiostegals.....	5.		6.	
Dorsal.....	11-19.		11-18.	
Anal.....	17.		17.	
Caudal.....	14.		14.	
Pectoral.....	13.		11.	
Ventral.....	1, 2.		1, 2.	

Genus THALASSOTHIA Berg.

Thalassophryne BERG, An. Mus. La Plata, Zool., vol. 1, 1893, p. 6, pl. 2.

Thalassothia BERG, An. Mus. Nac. Buenos Aires, vol. 4 (ser. 2, vol. 1), 1895, p. 66, pl. 1.

Thalassothia OGILBY, Ann. Queensland Mus., no. 9, pt. 2, 1908, pp. 46 and 54.

Dorsal spines four, the first two perforated for the passage of a venom duct, as in *Thalassophryne*.

Operculum developed as a strong spine which is hollow, like the first dorsal spines.

Teeth blunt conic.

Gill membrane apparently much narrower than in *Porichthys*, much as in *Thalassophryne*; not reaching much beyond the end of the opercular spine.

The first two anal rays are somewhat separated from the rest of the fin.

This genus differs from *Thalassophryne* in the number of dorsal spines; in the separation of the first anal rays from the rest of the fin and probably in the rather heavier body. In the only known species the dorsal and anal fins are shorter than in any known species of *Thalassophryne*.

Thalassothia differs from *Porichthys* in the dentition; in the number of dorsal spines; in the armament of the operculum; in the width of the gill membrane and in the stouter body.

Type.—*Thalassothia monteridensis* Berg.

THALASSOTHIA MONTEVIDENSIS Berg.

Thalassophryne monteridensis BERG, An. Mus. La Plata, Zool., vol. 1, 1893, p. 6, pl. 2.

Thalassothia monteridensis BERG, An. Mus. Nac. Buenos Aires, vol. 4 (ser. 2, vol. 1), p. 67, pl. 1.

Head 3. Depth apparently about equal to length of head. D. II-II-16. A. 2, 14. V., I 2. P. 16. Body short and stout, somewhat compressed behind the origin of the dorsal. Head depressed, wider than long. Eyes very small, apparently less than snout, which is about half the interorbital space. Opercular spine short, shorter than first dorsal spines.

It is impossible from the original description ("* * * la abertura de la boca muy poco oblicuamente ascendente, pero la parte mentoniana algo prominente, redondeada é inferiormente provista de pequeños lóbulos * * *," the aperture of the mouth little obliquely ascending, but the chin somewhat prominent, rounded, and provided below with small lobules) to be sure whether the mouth is nearly horizontal or nearly vertical, but from an examination of the illustration and from the fact that the eyes are said to be directed upward and forward ("* * * hacia arriba y adelante; * * *") it seems

probable that the mouth is more nearly horizontal than in *Thalassophryne*. The further description of the mouth as wide and almost transverse ("La boca es muy ancha y casi transversal"), taken in connection with the broad snout, is of little value in this connection. The maxillary apparently reaches somewhat beyond eye. The teeth are conic and obtuse, uniserial in mandible and premaxillary; those of the mandible and premaxillary described as pointing inward while those of the maxillary point outward. ("Los dientes son cónicos y obtusos, formando una serie en el premaxilar, y una en la mandíbula; los de la mandíbula y del premaxilar son dirigidos hacia adentro, y los del maxilar hacia afuera.") There are no teeth on the maxillary in *Thalassophryne*. The pectorals are obliquely rounded and reach past the base of the dorsal and anal. Dorsal and anal well separated from the base of the caudal. Caudal somewhat rounded.

Color yellowish or yellowish brown marbled with blackish and with three wide blackish cross bands along the base of the soft dorsal. The color fades to a dirty white below.

The type of the species was taken at Montevideo; later another one was seen at the same place, and Berg reports that the fishermen claim to have seen many of them at Maldonado.

We have no knowledge of this species further than the descriptions furnished by Berg.

EXPLANATION OF PLATES.

PLATE 31.

Thalassophryne dowi, copied from Proc. Cal. Acad. Sci., ser. 2, vol. 6, 1896, pl. 38.

PLATE 32.

- Fig. 1. *Thalassophryne punctata*, drawing by Miss Evelyn Mitchell from cotype No. 4632, Mus. Comp. Zool., Porto Seguro, Brazil. Coll. C. F. Hartt and E. Copeland, Thayer Expedition.
2. *Thalassophryne maculosa*, drawing by Miss Violet Dandridge from cotype of *Thalassophryne nattereri*, No. 12726, Mus. Comp. Zool., Para, Brazil. Coll. L. Agassiz, Thayer Expedition.
3. Photograph of opercular spine of *Thalassophryne dowi* No. 41430, U. S. N. M., Panama. Coll. Str. Albatross.
4. Photograph of opercular spine of *Porichthys greeni*, cotype of *Thalassophryne dowi*.

PLATE 33.

Thalassophryne maculosa, copied from Trans. Zool. Soc. London, vol. 6, pl. 68.

PLATE 34.

Thalassophryne reticulata, copied from Trans. Zool. Soc. London, vol. 6, pl. 68.